

National Hydrography Requirements and Benefits Study

Preliminary Results

May 20, 2016

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Executive Summary

U.S. Geological Survey (USGS) is considering an enhanced program to significantly improve the utility of hydrographic data for the U.S. and its territories. In order to determine the cost effectiveness of various enhanced program options, USGS is seeking to assess the requirements of users of hydrography data and the benefits to those users of improved hydrography data. The goal of this assessment, the National Hydrography Requirements and Benefits Study (HRBS), is to establish a set of national Business Uses (BUs) and requirements associated with hydrographic data. This information will then be used to evaluate the benefits of successfully supporting those requirements within the context of a national program.

This study is sponsored by USGS and the U.S. Department of Agriculture's (USDA's) Natural Resources Conservation Service (NRCS). It was conducted by Dewberry

In order to establish the set of national Business Uses and requirements associated with hydrographic data, user requirements and benefits were collected through an online questionnaire (Office of Management and Budget [OMB] Control Number 1028-0112). Mission Critical Activities (MCAs) and their associated requirements and benefits were identified by select Federal agencies, states, and other organizations. The MCA results were grouped into high-level Business Uses for each selected Federal agency and for each of the 50 states and other selected organizations. A list of the 25 Business Uses can be found in Appendix A. A geodatabase was developed to capture, store, and analyze the original questionnaire data. After a quality-control process including interviews with the states and responding agencies, a second geodatabase was developed to store summaries, refined versions, and aggregated content of the original data.

This report documents the preliminary findings of the HRBS. Further analysis of the data presented herein by USGS is anticipated, with the final outcome to be recommendations on enhanced program options and implementation recommendations.

Study Participation

Detailed responses to this study, in the form of 420 MCAs, were provided by 21 Federal agencies, all 50 states plus American Samoa and Washington D.C., 53 local and regional government organizations, eight Tribal governments, 14 private companies, four associations, and 20 other Not for Profit entities.

Table 1 below shows a breakdown of the study participation by organization type. Further breakdown of the Federal, state, Tribal, and association participation can be found in Section 4.1. Full details of all participating entities can be found in the summary reports for the Federal agencies, states, and associations found in Appendixes B, C, and D.

Table 1. Breakdown of study participation by organization type

Organization Type	Number of Agencies/ Entities	Number of MCAs	Percent of MCAs per Organization Type
Federal Agencies and Commissions	21	54	13%
Not for Profit	24	25	6%
Private or Commercial	14	16	4%

Organization Type	Number of Agencies/ Entities	Number of MCAs	Percent of MCAs per Organization Type
Regional, County, City or Other Local Government	53	80	19%
State Government	183	237	56%
Tribal Government	8	8	2%
Total	303	420	100%

Current Use of National Datasets

For each of the 420 reported MCAs, study participants were asked to indicate what national hydrography datasets are currently being used to address the water information needs of the MCA. Specifically, users were asked about their use of the National Hydrography Dataset (NHD), Watershed Boundary Dataset (WBD), and NHDPlus.

Figure 1 below provides a summary of the current use of the NHD, WBD, and NHDPlus datasets. Study respondents reported using NHD, WBD, and/or NHDPlus data for 88 percent of MCAs; another dataset in addition to the NHD, WBD, and/or NHDPlus data for 34 percent of the MCAs; and another dataset instead of the NHD, WBD, and/or NHDPlus data for 8 percent of the MCAs. Study respondents reported using no hydrography data for only 4 percent of the MCAs.

When another water-related dataset is used, 60 percent of the time it is state or locally developed and/or maintained hydrography data. These locally maintained data are either of higher resolution than the national datasets, having been collected or improved to fit recently collected lidar, orthoimagery, or parcel data, and/or have locally improved or added attributes that were customized to serve the MCA's business needs.

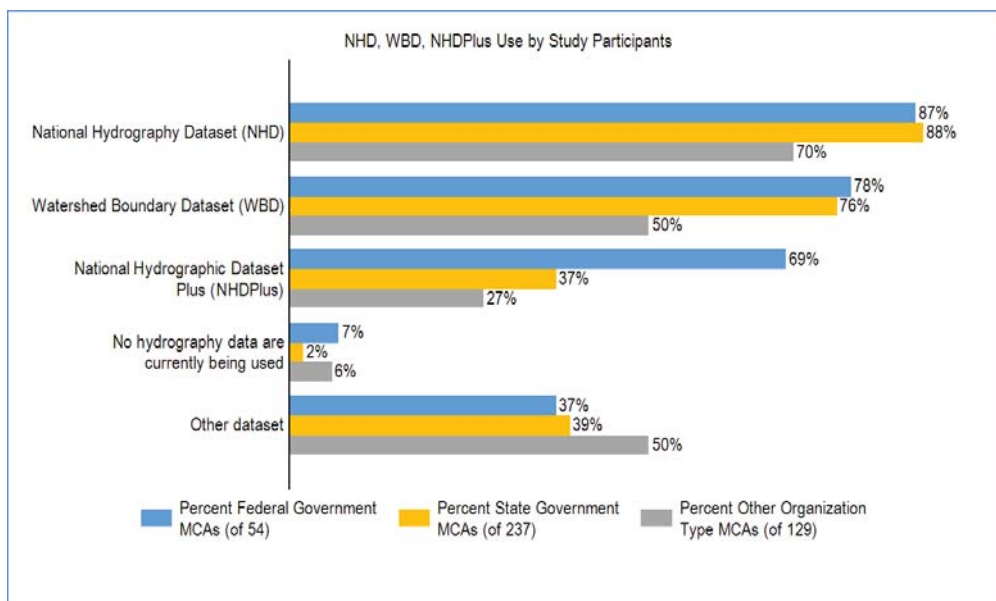


Figure 1. Summary of current use of the NHD, WBD, and NHDPlus datasets

Mission Critical Activities

For each of the 420 MCAs, study participants were asked to describe the MCA in their own words. Study respondents were also asked to identify the geographic area requirements for each MCA. Maps depicting the area of interest for each MCA are included in Appendixes B, C, and D. Figure 2 shows the distribution of the spatial extents of all 420 MCAs aggregated by HUC8 areas.

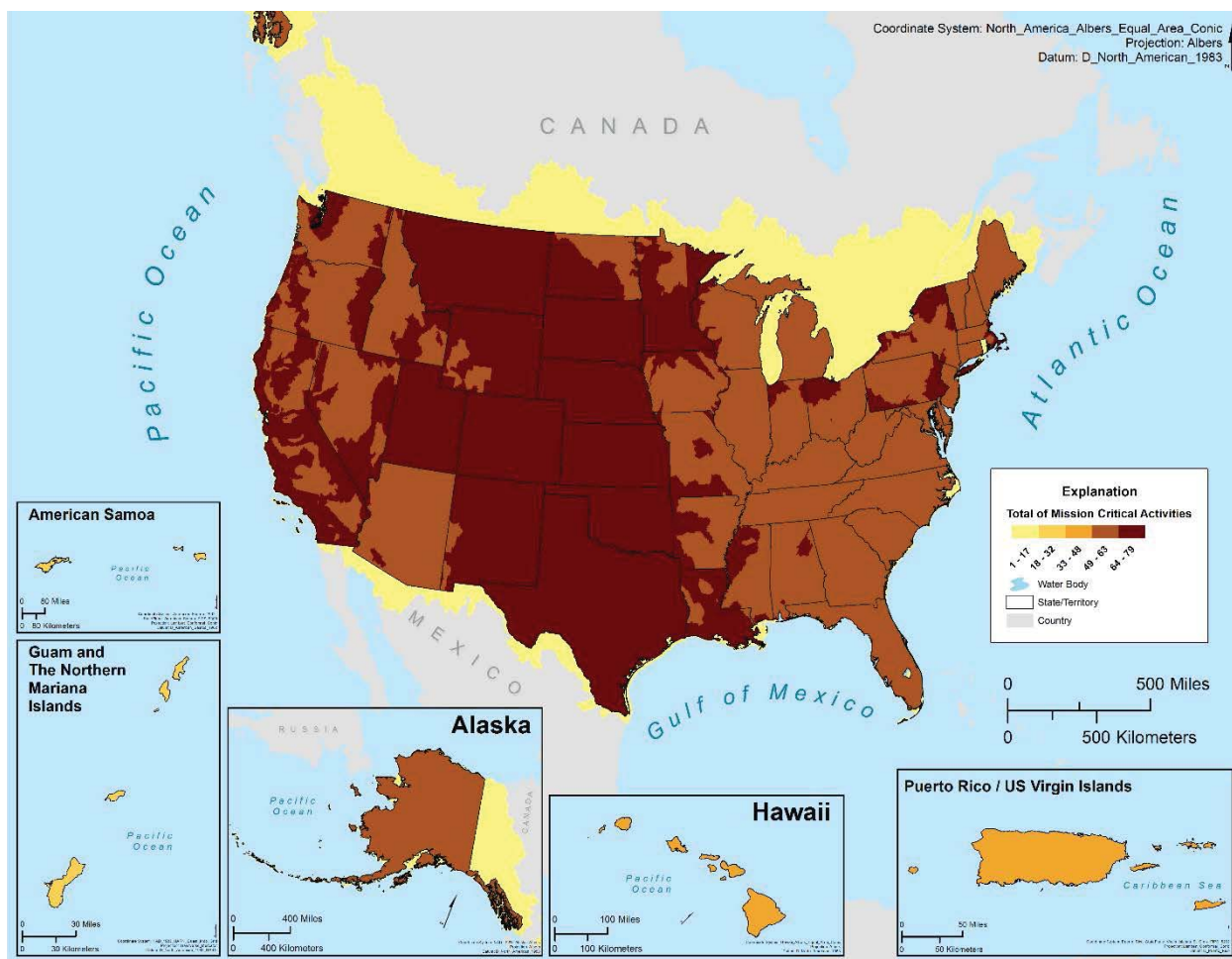


Figure 2. Distribution of spatial extents for all 420 MCAs aggregated by HUC8 areas

Business Uses

Study participants were requested to assign one (or more) of 25 pre-defined Business Uses to each MCA, in addition to providing an MCA title and description. The Business Uses are described in Section 4.3 and in detail in Appendix E. Because study participants were asked to describe their MCA in their own words and to assign a Business Use to each, there was a fairly wide variety among how the Business Uses were assigned to the MCAs. Some Business Uses seemed to be interpreted broadly and multiple types of activities were associated with them. Others seemed to be more narrowly interpreted. BU #4 Water Quality and BU #15 Flood Risk Management were among the more consistently applied Business Uses. BU #1 River and Stream Flow Management, BU #2 Natural Resources Conservation, BU #3 Water Resource Planning and Management, and BU #5 River and Stream Ecosystem Management had the widest variety of MCA descriptions ascribed to them.

Table 2 below shows the 25 Business Uses ranked by the total number of MCAs per Business Use. The top six Business Uses by overall number of MCAs, Water Quality, Water Resource Planning and Management, Flood Risk Management, River and Stream Flow Management, Natural Resources Conservation, and River and Stream Ecosystem Management account for approximately 75 percent of the MCAs.

Table 2. Business Uses ranked by total number of MCAs per Business Use

BU	No. of MCAs	Business Use	BU	No. of MCAs	Business Use
4	79	Water Quality	7	5	Forest Resources Management
3	69	Water Resource Planning and Management	22	4	Health and Human Services
15	54	Flood Risk Management	11	3	Geologic Resource Assessment and Hazard Mitigation
1	44	River and Stream Flow Management	13	3	Renewable Energy Resources
2	34	Natural Resources Conservation	14	3	Oil and Gas Resources
5	34	River and Stream Ecosystem Management	19	3	Marine and Riverine Navigation Safety
20	18	Infrastructure and Construction Management	25	3	Recreation
21	17	Urban and Regional Planning	12	2	Resource Mining
10	9	Agriculture and Precision Farming	16	2	Sea Level Rise and Subsidence
24	9	Education K-12 and Beyond	8	1	Rangeland Management
6	8	Coastal Zone Management	17	1	Wildfire Management, Planning, and Response
9	8	Wildlife and Habitat Management	23	0	Real Estate, Banking, Mortgage, and Insurance
18	7	Homeland Security, Law Enforcement, and Disaster Response		420	Total

Requirements

For each of the 420 MCAs, study participants were asked to provide detailed information about the data required to accomplish the mission. Users were asked to provide information regarding the required positional accuracy, stream density, smallest contributing watershed, smallest mapped waterbody, update frequency, post-event updates, and level of detail for each MCA. Users were also asked what characteristics or features and analytical functions are required and about the level of integration required between hydrography data and other datasets for the hydrography data to satisfy MCA requirements.

Additionally, non-MCA specific requirements were collected for hydrography data access methods including required data types or formats, geographic extents, data or service access methods, required elevation-hydrography data integration, required raster elevation-hydrography data integration, and the impact of hydrography data errors.

Section 4.5 provides details about the MCA specific and non-MCA specific requirements by organization type (Federal agencies, State government, and other entities). Section 5.5 provides information about the spatial distribution of selected MCA requirements.

Figure 3 below shows the distribution of the positional accuracy responses. The most frequently requested positional accuracy by Federal agencies was +/- 40 feet while the overall most frequently requested positional accuracy was +/- 3 feet. However, providing data with positional accuracy of +/- 40 feet would only meet 35 percent of Federal agency positional accuracy requirements and 23 percent of overall positional accuracy requirements. Providing data with positional accuracy of +/- 7 feet would meet 76 percent of Federal agency requirements, 73 percent of state government requirements, and 65 percent of the overall reported user requirements, but only 44 percent of other organization type requirements.

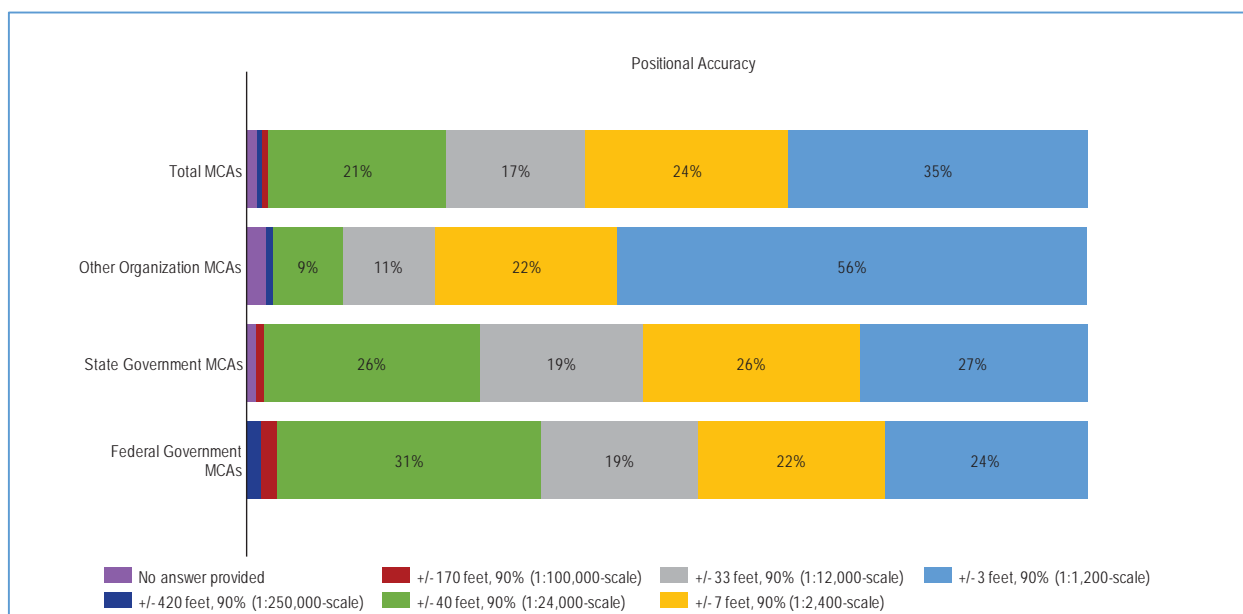


Figure 3. Distribution of positional accuracy responses

Figure 4 below shows the distribution of the stream density responses. The most frequently requested stream density by Federal agencies was 2.5 miles of channel per square mile while the overall most frequently requested stream density was 5.0 miles of channel per square mile. Providing data with stream density of 2.5 miles of channel per square mile would meet 69 percent of Federal agency requirements, 61 percent of state government requirements, and 61 percent of the overall reported user requirements.

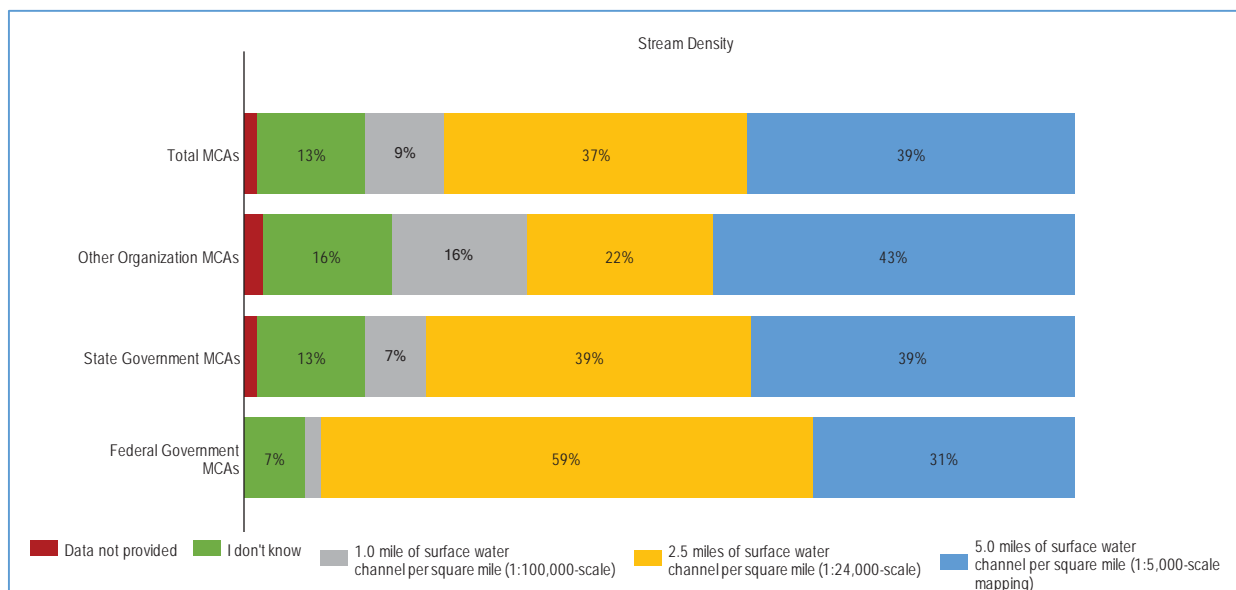


Figure 4. Distribution of stream density responses

Figure 5 on the following page shows the distribution of the smallest contributing watershed responses. The most frequently requested smallest contributing watershed by Federal agencies was 60 acres while the overall most frequently requested smallest contributing watershed was 6 acres. Providing data with a smallest contributing watershed of 60 acres would meet 80 percent of Federal agency requirements, 71 percent of state government requirements, and 71 percent of overall user requirements. Providing data with smallest contributing watershed of 6 acres would meet 99.5 percent of the reported user requirements.

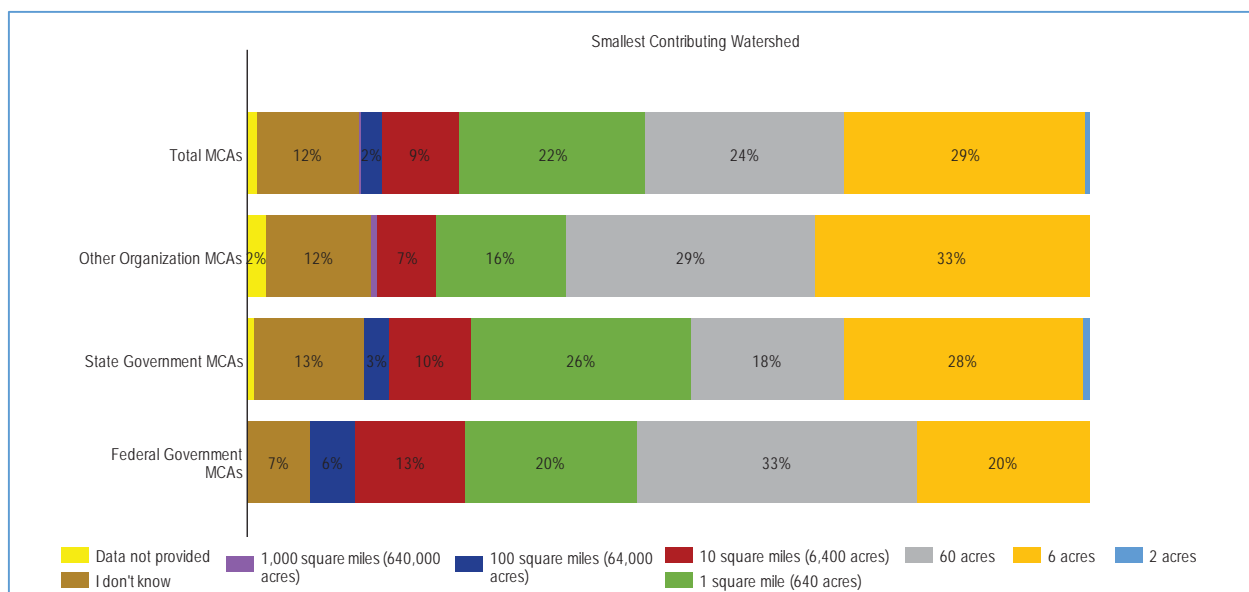


Figure 5. Distribution of smallest contributing watershed responses

Figure 6 below shows the distribution of the smallest mapped waterbody responses. The most frequently requested smallest mapped waterbody by Federal agencies was tied at less than an acre and one acre while the overall most frequently requested smallest mapped waterbody was less than an acre. Providing data with a smallest mapped waterbody of one acre would meet 74 percent of Federal agency requirements, 68 percent of state government requirements, and 66 percent of the overall reported user requirements.

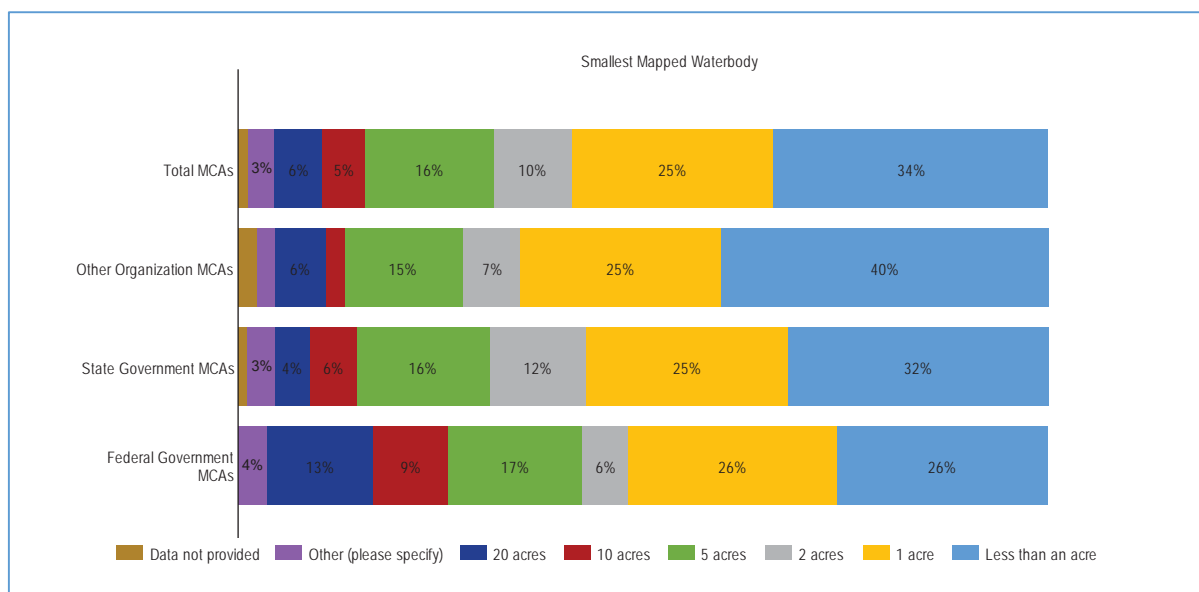


Figure 6. Distribution of the smallest mapped waterbody responses

Figure 7 below shows the distribution of the update frequency responses. The most requested update frequency was annually. However, providing updates every 2-3 years would meet 65 percent of Federal agency requirements, 65 percent of state government requirements, and 68 percent of the reported overall user requirements.

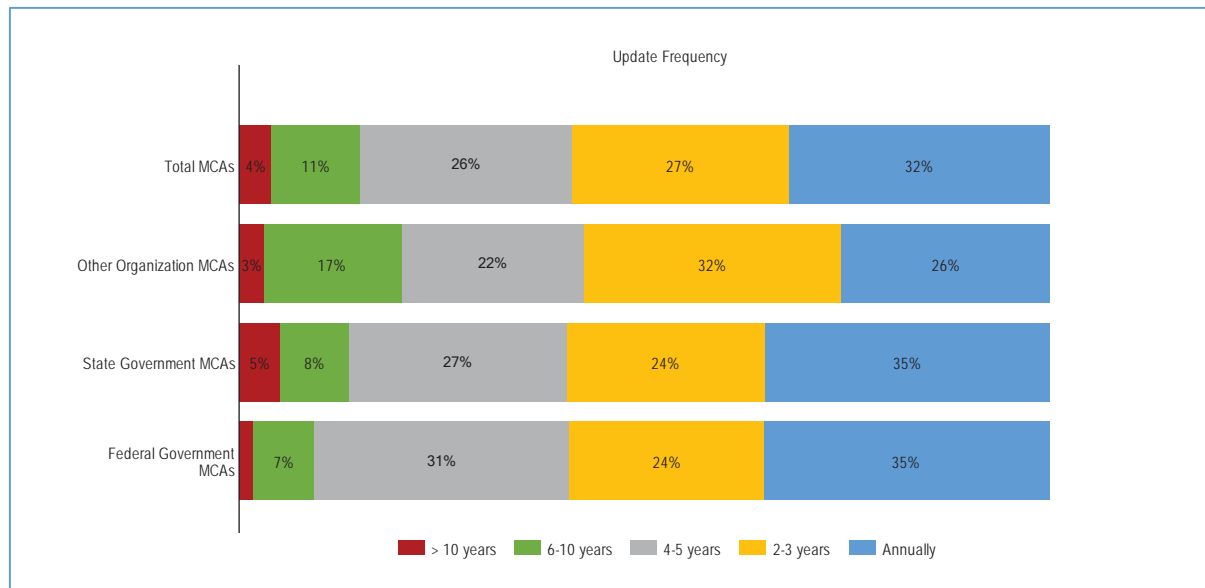


Figure 7. Distribution of the update frequency responses

Figure 8 below shows the distribution of the post-event update responses. The most frequently reported response by Federal agencies was “highly desirable,” while the most frequently requested state government response and the overall most frequently requested response was that post-event updates would be “nice to have.”

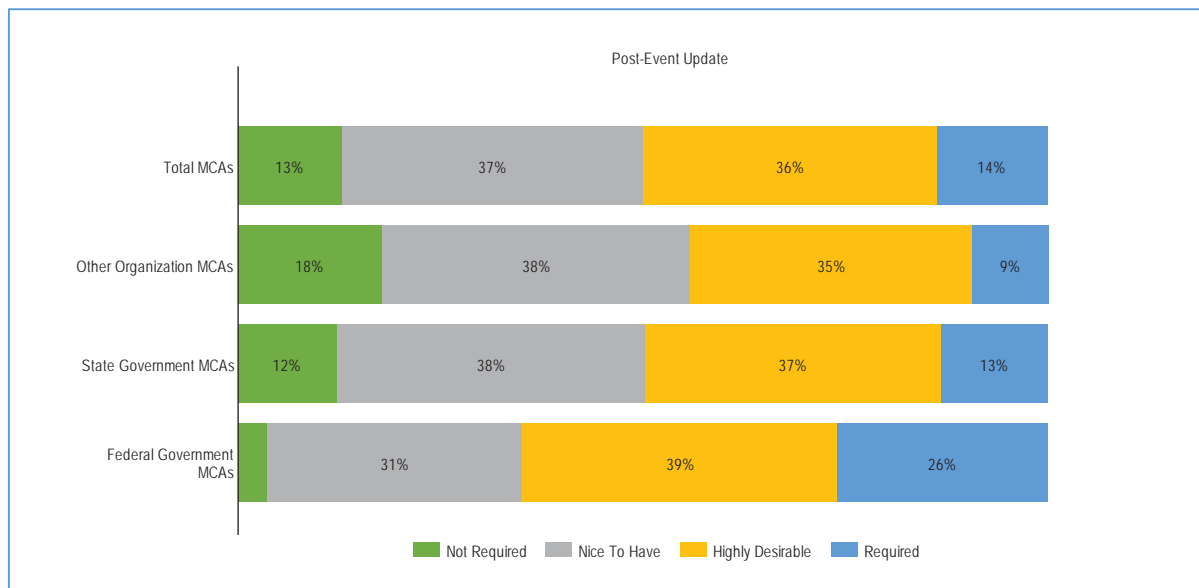


Figure 8. Distribution of the post-event update responses

Figure 9 below shows the distribution of the level of detail responses. A total of 70 percent of Federal agencies and 67 percent of overall study participants reported a requirement for best available data. These results appear to refute a commonly held belief that Federal agencies need consistent data as opposed to best available. Study respondents did note that disparities in level of detail cause modeling problems and also noted a desire for tools that would allow best available data to be selected or generalized such that a consistent level of detail could be achieved for modeling purposes from best available data.

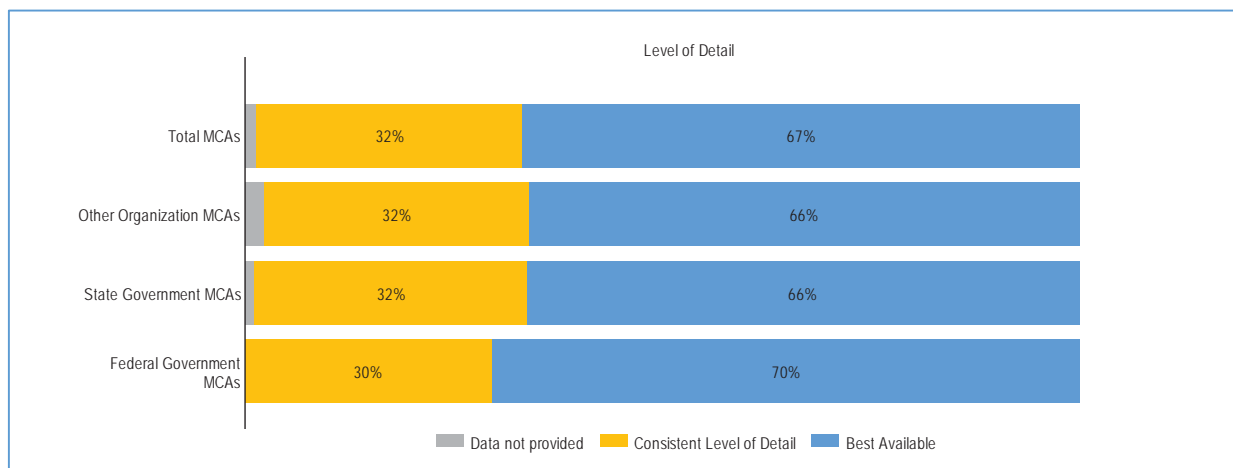


Figure 9. Distribution of the level of detail responses

Table 3 below shows the distribution of the top five (of 35 included in the study) required characteristics and analytical functions ranked by the number of MCAs for which Federal agencies reported the requirement. Wetlands data are the most frequently required characteristic by Federal agencies. Calculate drainage area is the most frequently required analytical function by States and overall (it is ranked second for Federal agencies).

Table 3. Top five required characteristics and analytical functions ranked by number of MCAs

Required Characteristics/Analytical Functions	Number of Federal Gov't. MCAs (of 54)	Percent of Federal Gov't. MCAs	Number of State Gov't. MCAs (of 237)	Percent of State Gov't. MCAs	Number of Other Organization Type MCAs (of 129)	Percent of Other Organization Type MCAs	Total Number of MCAs (of 420)	Percent of Total MCAs
Wetlands	47	87%	145	61%	77	60%	269	64%
Calculate drainage area	44	81%	183	77%	102	79%	329	78%
Flow periodicity	43	80%	149	63%	75	58%	267	64%
Linkages to stream gage observations	43	80%	156	66%	83	64%	282	67%
Delineate catchment	42	78%	146	62%	85	66%	273	65%

Table 4 on the following page shows the top five (of 20 included in the study) datasets ranked by the number of MCAs for which Federal agencies indicated that integration with that data type was “Required.” The options provided for answering this question in the online questionnaire were “Required,” “Highly Desirable,” “Nice to Have,” and “Not Required.” Integration of hydrography data with elevation data was the most frequently required, followed by stream flow, wetlands, soils, and land cover data. The top five were the same for all study participants, although in differing order. Additionally, when the dataset was “Required,” it was most frequently needed to “Perform Geospatial Analysis.”

Table 4. Top five datasets ranked by number of MCAs

Data Type	Number of Federal Gov't. MCAs for which Data Integration is Required (of 54)	Percent of Federal Gov't. MCAs for which Data Integration is Required	Number of State Gov't. MCAs for which Data Integration is Required (of 237)	Percent of State Gov't. MCAs for which Data Integration is Required	Number of Other Organization Type MCAs for which Data Integration is Required (of 129)	Percent of Other Organization Type MCAs for which Data Integration is Required	Total Number of MCAs for which Data Integration is Required (of 420)	Percent of Total MCAs for which Data Integration is Required
Elevation	40	74%	149	63%	85	66%	274	65%
Stream Flow	37	69%	130	55%	64	50%	231	55%
Wetlands	35	65%	103	43%	31	24%	169	40%
Soils	33	61%	75	32%	48	37%	156	37%
Land Cover	30	56%	109	46%	58	45%	197	47%

In addition to the MCA-specific requirements discussed above, study respondents were asked to provide information about their program-wide (all identified MCAs) hydrography data requirements. These questions were not intended to apply to specific MCAs but to broader agency or general program hydrography data needs.

The following is a summary of the non-MCA specific requirements most frequently reported by study respondents.

- Data types or formats: For vector format data, Environmental Systems Research Institute (Esri) Shapefiles and file geodatabases are the most frequently required. For raster format data, Geospatial Tagged Image File Format (GeoTIFF), and Esri Grid format data are the most frequently required. However, all options receive considerable use.
- Geographic extent: Data tiled by HUC12 and HUC8 are the most frequently required. However, all options appear to be widely used.
- Data or service access methods: 95 percent of users require the ability to download data. Online services appear popular as well.
- Elevation-hydrography data integration: The most frequently reported requirement is for hydrography data to align with elevation data at 1:12,000-scale or larger.
- Raster elevation-hydrography data integration: The most frequently reported requirement is to determine new flow paths across the land surface into existing channels.
- Hydrography data errors with the greatest impact: The error with the greatest impact reported by study respondents is tributaries that are not connected to the main river, followed by stream flow reversal.
- Elevation-derived catchments need to be within 5 percent of the actual area.
- Error resolution needs to be within 2-30 days.
- 82 percent of study respondents would definitely or probably use a web-based tool to report errors.

Benefits

Study respondents were asked to provide information for each reported MCA about their estimated annual program budgets that are supported by hydrography data. They were also asked to estimate what their current annual benefits are, and what future annual benefits they are likely to receive from enhanced hydrography data. The future benefits would be those likely to be received if all of their reported requirements were met. Sections 4.6 and 5.6 provide additional details about the reported benefits.

For the 420 MCAs, study respondents reported a total estimated annual program budget of \$18.5 to \$22.5 billion for programs supported by hydrography data. It is clear that stakeholders are already receiving significant benefits from the currently available hydrography data; For the 420 MCAs, study respondents reported \$538.5 to \$544 million in estimated annual benefits from the currently available hydrography data. And if all of the reported hydrography data requirements could be met by enhanced datasets, the estimated future annual benefits from these enhanced hydrography data would be an additional \$602.5 to \$605 million over and above the current estimated annual benefits.

Study respondents were unable to provide estimated current annual dollar benefits for 192 (46 percent) of the MCAs. And study respondents were unable to provide estimated future annual dollar benefits for 145 (35 percent) of the MCAs. This means that the estimated annual dollar benefits, both current and future, are likely to be underestimated. However, as a high level State manager who was not able to quantify future benefits noted, the benefits to having high quality data to support environmental decisions that will affect generations is “immeasurable. It is worth millions of dollars.”

Table 5 below provides a summary by organization type of the estimated annual program budgets supported by hydrography data, estimated annual dollar benefits provided by the currently available hydrography data, and estimated future annual benefits from enhanced hydrography data.

Table 5. Summary by organization type of the estimated annual program budgets

Organization Type	Total Number of MCAs	Estimated Annual Program Budget (in millions)	Estimated Current Annual Benefits (in millions)	Estimated Future Annual Benefits (in millions)
Federal Agencies and Commissions	54	\$11,584.65	\$212.35	\$308.48
Not for Profit	25	\$73.68	\$3.02	\$27.23
Private or Commercial	16	\$7.47	\$1.28	\$2.13
Regional, County, City or Other Local Government	80	\$282.70	\$137.03	\$19.74
State Government	237	\$6,523.41	\$184.62	\$244.73
Tribal Government	8	\$1.11	\$0.21	\$0.24
Total	420	\$18,473.01	\$538.50	\$602.55

Table 6 on the following page shows the Business Uses ranked by those with the greatest estimated average annual future dollar benefits from enhanced hydrography data. This table also includes estimated annual program budgets supported by hydrography data and estimated annual dollar benefits provided by the currently available hydrography data. The overall average estimated future benefit per MCA is \$1.4 million.

As a way to account for benefits that could not be quantified in terms of dollars, users were asked about potential qualitative future benefits. Table 6 also includes a weighted value for the future qualitative benefits for education or public safety, environmental or ecosystems, and human lives saved. Each was quantified as Major, Moderate, or Minor. The weighting was done as follows: Major = 5, Moderate = 3, Minor = 1, Don't Know, Not Applicable, No response = 0. Note that no dollar values were estimated for these categories of qualitative benefits.

Table 6. Business Uses ranked by estimated average annual future dollar benefits

BU Number	Business Use	Total Number of MCAs	Estimated Annual Program Budget (in millions)	Estimated Current Annual Benefits (in millions)	Estimated Future Annual Benefits (in millions)	Average Estimated Future Annual Benefits /MCA (in millions)	Education or Public Safety Benefits Weighted Value	Environmental Benefits Weighted Value	Human Lives Saved Weighted Value
BU 1	River and Stream Flow Management	44	\$763.58	\$220.07	\$154.73	\$3.52	97	107	39
BU 5	River and Stream Ecosystem Management	34	\$1,000.72	\$13.96	\$67.00	\$1.97	78	119	17
BU 3	Water Resource Planning and Management	69	\$988.88	\$98.11	\$115.88	\$1.68	155	168	70
BU 4	Water Quality	79	\$1,672.41	\$115.46	\$121.48	\$1.54	189	254	68
BU 15	Flood Risk Management	54	\$636.11	\$56.12	\$75.86	\$1.40	168	124	133
BU 9	Wildlife and Habitat Management	8	\$1,041.45	\$0.18	\$10.08	\$1.26	26	27	5
BU 7	Forest Resources Management	5	\$254.39	\$1.76	\$6.01	\$1.20	19	19	7
BU 18	Homeland Security, Law Enforcement, & Disaster Response	7	\$1.75	\$0.10	\$5.50	\$0.79	18	13	12
BU 6	Coastal Zone Management	8	\$63.30	\$10.71	\$5.55	\$0.69	29	27	21
BU 24	Education K-12 and Beyond	9	\$1.56	\$0.53	\$5.36	\$0.60	28	26	3
BU 12	Resource Mining	2	\$500.10	\$1.03	\$1.10	\$0.55	10	10	6
BU 2	Natural Resources Conservation	34	\$6,956.80	\$10.17	\$17.76	\$0.52	84	111	19
BU 20	Infrastructure and Construction Management	18	\$1,088.72	\$1.65	\$8.73	\$0.49	53	60	26
BU 10	Agriculture and Precision Farming	9	\$21.75	\$1.25	\$2.15	\$0.24	21	34	7
BU 21	Urban and Regional Planning	17	\$1,763.51	\$2.17	\$3.42	\$0.20	36	46	18
BU 13	Renewable Energy Resources	3	\$1,547.85	\$2.80	\$0.58	\$0.19	1	5	0
BU 16	Sea Level Rise and Subsidence	2	\$1.00	\$0.35	\$0.35	\$0.18	6	6	6
BU 22	Health and Human Services	4	\$58.45	\$0.50	\$0.50	\$0.13	11	16	1
BU 8	Rangeland Management	1	\$20.43	\$0.00	\$0.10	\$0.10	3	5	0
BU 25	Recreation	3	\$2.90	\$1.41	\$0.17	\$0.06	11	11	7
BU 14	Oil and Gas Resources	3	\$24.00	\$0.10	\$0.10	\$0.03	9	11	7
BU 19	Marine and Riverine Navigation Safety	3	\$43.00	\$0.03	\$0.10	\$0.03	5	7	3
BU 11	Geologic Resource Assessment and Hazard Mitigation	3	\$0.35	\$0.04	\$0.05	\$0.02	5	1	3
BU 17	Wildfire Management, Planning, and Response	1	\$20.00	\$0.01	\$0.01	\$0.01	5	5	5
	Total	420	\$18,473.01	\$538.50	\$602.55	\$1.43	1067	1212	483

Figure 10 below shows the spatial distribution of the estimated future annual dollar benefits of all 420 MCAs aggregated by HUC8 areas per square mile. Areas with darker colors have greater numbers of areas of interest. Similar maps showing the estimated future annual dollar benefits for each individual Business Use aggregated by HUC8s are provided in Appendix E.

It is likely that most states and many county or local entities have additional MCAs and Business Uses that were not reported for this study. Since the representation of state and local agencies varied across states and the Business Uses were self-selected, it is likely that additional areas across the U.S. would have an interest in and potentially receive benefits for one or more of the Business Uses than what is currently described or reflected in the study data. Figure 10 shows concentrations of estimated future annual benefits in a few areas due to state agencies that reported rather significant benefits. However, it is likely that other states with similar activities may realize future benefits from enhanced hydrography data that were unable to be estimated, which would increase the estimated future annual benefits in other areas.

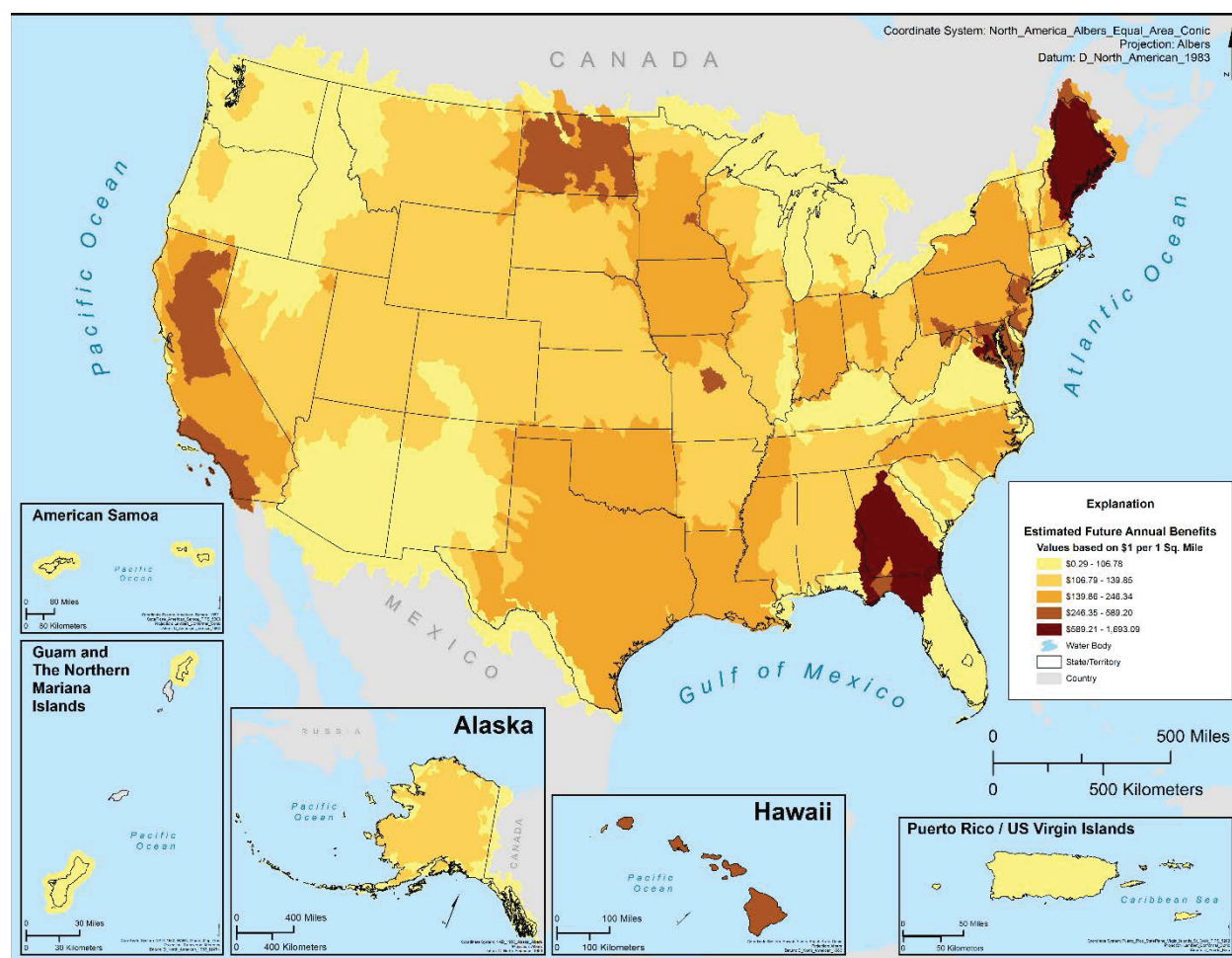


Figure 10. Spatial distribution of the estimated future annual dollar benefits of all 420 MCAs aggregated by HUC8 areas

Conclusions and Recommendations

The following observations and conclusions are provided based on the data collected for the HRBS and contained in the study geodatabase. Further analysis of the study data will be needed to associate benefits

with fulfilling individual requirements and to plan program implementation scenarios. A few recommendations for future analysis considerations are also provided.

- Per the OMB restrictions, only 350 responses from the public (including state and local government employees) could be gathered. Study participants were selected by state POCs and may not represent all relevant agencies in all states. In fact, it is likely that most states and many local entities are likely to have additional MCAs and Business Uses with unreported requirements and would likely receive future benefits from enhanced hydrography data. A methodology for identifying and filling perceived gaps may need to be considered when further analyzing the data and developing implementation scenarios. For instance, data were provided by only 13 state Departments of Transportation (DOTs), but all states are likely to have a DOT that has hydrography requirements and benefits.
- The vast majority (90 percent) of the MCAs were provided by government agencies (Federal, state, regional, county, city, local, and Tribal). A total of 25 MCAs (6 percent) were provided by Not for Profit entities. A total of 16 (4 percent) MCAs were provided by private or commercial entities. However, the private or commercial entities were primarily contractors to government agencies. There was little or no representation of large-scale private entities such as the oil and gas industry, major utilities, or agribusiness. It should be noted that these unrepresented private entities are likely to also make use of national hydrography datasets, have requirements for hydrography data enhancements, and are likely to receive potentially significant but undocumented annual benefits from future enhanced hydrography datasets. Future analyses may not be able to quantify the requirements from or benefits to these unrepresented private entities, but their additional benefits may be able to be acknowledged.
- The MCAs reported by the Federal agencies (54) typically reflect nationwide interests with nationwide or nearly nationwide areas of interest. The remainder of the MCAs (237 from state government and 129 from other organizations) typically represent smaller areas of interest. Simply counting the number of MCAs for which requirements or benefits apply would be misleading. For this reason, in this report the MCA totals were broken down and reported by Federal agencies, state government agencies, and other entities along with the overall totals. This allows the responses that cover generally larger geographic areas represented by a smaller number of Federal agencies and the requirements that generally cover smaller but more numerous state and local geographic areas to be reported separately. Future analyses will need to take the geographic distribution of the requirements and benefits into account (not just numbers) using the MCA areas of interest contained in the study geodatabase.
- There was considerable variation in how the MCAs were defined and described by study participants. Some MCAs appear to have been described in terms of the respondent's agency's organization, some in terms of their daily activities. Some MCAs were very broad and encompassed multiple Business Uses and some were quite narrowly defined. This is further indication that further analyses using only the numbers of MCAs may not be useful.
- Study participants ascribed five or fewer MCAs to eleven of the 25 pre-defined Business Uses. For example, two MCAs were ascribed to BU #16, Sea Level Rise and Subsidence, and one MCA was ascribed to BU #17 Wildfire Management, Planning, and Response. Agencies or entities with

multiple responsibilities likely chose the Business Use that makes up the majority of their portfolio of business. However, it is likely that more than two agencies include planning for sea level rise in their mission and that most western states have a concern for wildfire management. When further analyzing requirements and benefits by Business Use, consideration should be given to imputing requirements for and benefits from hydrography data from the available information where it appears that there are significant gaps in the reported data.

- The top five requirements for integration with other datasets were elevation, stream flow, wetlands, soils, and land cover, with integration with elevation data being the top requirement. When developing program implementation scenarios for analysis, consideration should be given to evaluating whether future hydrography data models may be able to accommodate some or all of these data integration requirements.
- The HRBS results appear to refute a commonly held belief that Federal agencies need consistent data as opposed to best available. A total of 70 percent of Federal agencies and 67 percent of overall study participants reported a requirement for best available data. Study respondents did note that disparities in level of detail cause modeling problems and also noted a desire for tools that would allow best available data to be selected or generalized such that a consistent level of detail could be achieved for modeling purposes from best available data.
- The reported estimated future annual benefits are most likely underestimated. Study respondents were unable to provide dollar estimates for future annual benefits for 35 percent of the MCAs.
- Per OMB, no dollar benefits were allowed to be collected for the societal benefits (education or public safety, environmental, and human lives saved). However, study respondents noted moderate or major benefits for education or public safety for 62 percent of MCAs and moderate or major environmental benefits for 67 percent of the MCAs. While these benefits cannot be quantified, they should not be discounted.
- When the estimated future annual benefits are mapped by MCA area of interest, several concentrations of benefits are revealed. These reflect several state agencies with rather significant benefits. It should be noted that other states may have unreported but similar benefits.
- The estimated future annual benefits are associated with fulfilling all stated requirements for each MCA. When further analyzing the data and developing implementation scenarios, a methodology will be needed for degrading the benefits if not all requirements can be fulfilled by a given scenario. Having so many different requirements to consider will make this a challenge.
- While the requirements and benefits assigned to specific MCAs would not be duplicated or biased due to the way they were aggregated into Business Uses, the reader is cautioned to understand the inherent flaws associated with any consolidation of this information. Likewise, specific user requirements may require more detailed analysis of the study database to understand the full need or value of fully meeting a particular need.